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(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
13 June 2002 (13.06.2002)

PCT

(10) International Publication Number
WO 02/47072 A1

(51) International Patent Classification[7]**:** **G11B 7/0045**

(21) International Application Number: PCT/EP01/13735

(22) International Filing Date: 23 November 2001 (23.11.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
00204315.6 4 December 2000 (04.12.2000) EP

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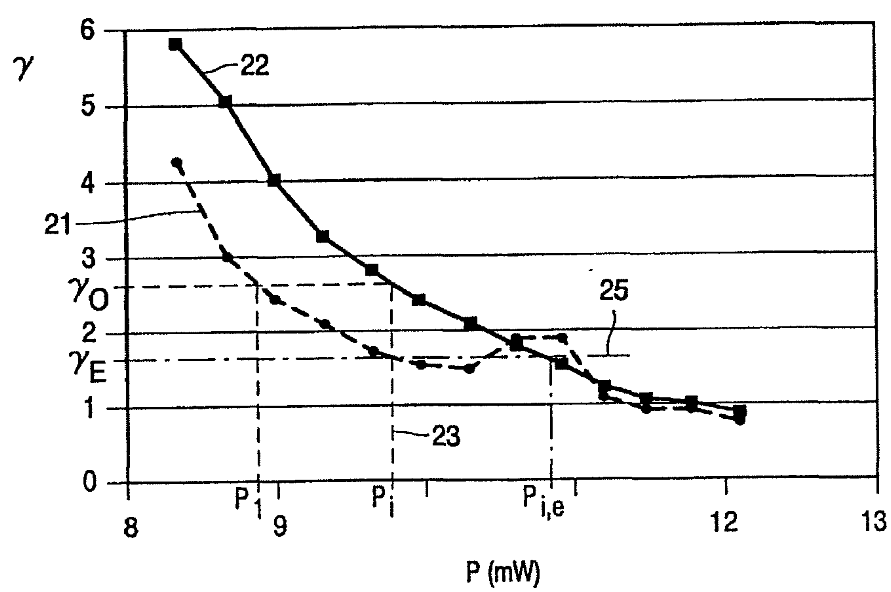
(81) Designated States *(national)***:** AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)***:** ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

[Continued on next page]

(54) Title: METHOD AND OPTICAL RECORDING APPARATUS FOR DETERMINING THE OPTIMUM WRITE POWER



(57) Abstract: A method and an optical recording apparatus for determining the optimum write power in an OPC-procedure are described. The method involves erasing a test area, recording test patterns in the test area, reading the recorded test patterns and determining the optimum write power from signal portions of the read signal. Erasing the test area, even when no signals are recorded therein, produces a reliable and unambiguous value of the optimum write power.

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Method and optical recording apparatus for determining the optimum write power

The invention relates to a method for setting an optimum value (P_{opt}) of a write power level (P) of a radiation beam for use in an optical recording apparatus for writing information on an optical recording medium, the optical recording medium comprising an information layer having a phase reversibly changeable between a first state and a second state, the information being written on the optical recording medium in the form of marks by applying the radiation beam to an area of the information layer so as to cause the area of the information layer to become the first state, thereby forming the mark, the method comprising a first step of writing a series of test patterns, each test pattern comprising marks, in a test area on the recording medium, each test pattern being written with a different value of the write power level (P) of the radiation beam, a second step of reading the written test patterns so as to form corresponding read signal portions, and a third step of selecting the optimum value (P_{opt}) of the write power level (P) in dependence on the read signal portions.

The invention also relates to an optical recording apparatus for recording information on an optical recording medium, comprising a radiation source for emitting a radiation beam for recording information on the recording medium, the radiation beam having a controllable value of a write power level (P), a control unit operative to record a series of test patterns in a test area on the recording medium, each pattern being recorded with a different value of the write power level (P), a read unit for reading the recorded test patterns and for forming corresponding read signal portions, and setting means for setting an optimum value (P_{opt}) of the write power level in dependence on the read signal portions.

A method and apparatus according to the first paragraph are known from the European patent application No. EP 0 737 962. The apparatus uses a method for setting the optimum write power (P_{opt}) of the radiation beam which includes the following steps. First the apparatus records a series of test patterns on the recording medium, each test pattern with increasing write power (P). Next, it derives the modulation (M) of each recorded test pattern from the read signal portions corresponding to each of the test patterns. It calculates the derivative of the modulation (M) as a function of the write power (P) and normalizes the derivative by multiplying it by the write power (P) over the modulation (M). The intersection

of the normalized derivative (γ) with a preset value (γ_{target}) determines a target write power level (P_{target}). Finally, the target write power (P_{target}) is multiplied by a parameter (ρ) so as to obtain an optimum value (P_{opt}) of the write power level (P) best suited for recording on the recording medium. The value of the parameter (ρ) is read from the recording medium itself. The test patterns are recorded on the recording medium by applying write power (P) values in a range around a given value (P_{ind}) which is also read from the recording medium itself.

The test patterns are recorded in a test area on the recording medium. In general this test area is an area specially reserved for recording test patterns. Such a reserved area is, for example, know as a Drive Test Zone or as a Disc Test Zone. The test area may consist of one continuous area or alternatively may be composed of several sub-areas.

It is to be noted that the not prepublished European patent application PHNL000685 describes an alternative method and an apparatus using the alternative method. In this alternative method, the optimum value (P_{opt}) of the write power level (P) is determined directly from the relation between the modulation times the write power level (i.e., M·P) and the write power level (P).

In an optical recording apparatus it is important to record information on optical recording media with the correct power of the radiation beam. A media manufacturer cannot give this correct power in an absolute way (for example, pre-recorded on the disc) because of environment and apparatus -to- apparatus deviations for every recording medium and recording apparatus combination. The known methods for setting the optimal write power (P_{opt}) take the different characteristics of the recording media into account. Furthermore, the methods are independent of the specific recording apparatus. They are designed for providing a proper setting of the write power of the radiation beam for each combination of recording apparatus and recording medium. Such methods are often referred to as OPC (Optimum Power Calibration) procedures.

However, it is a disadvantage of the know method that an unambiguous value for the optimal write power level (P_{opt}) is not always obtained. This is especially the case for recording media comprising an information layer having a phase reversibly changeable between a first state and a second state such as, for example, an information layer of the phase change type having a crystalline and an amorphous state. On such a phase change type information layer a mark is formed, for example, by an amorphous area within a crystalline surrounding. Recording media comprising a phase change type information layer include, for example, CD-RW and DVD-RW discs.

It is to be noted that within the scope of this application marks are considered to include all detectable areas on a recording medium such as, for example, amorphous areas within a crystalline surrounding on a recording medium of the phase change type discussed above. However, marks are not limited to optically detectable regions but magnetically or magneto-optically detectable regions may alternatively be used.

It is an object of the present invention to provide a method according to the opening paragraph which determines an unambiguous optimum value of the write power level.

This object is achieved when the method set forth in the preamble is characterized in that the method also includes, before the first step, an initialization step of applying the radiation beam having an erase power level to the test area so as to cause the information layer in the test area to become the second state. When the test area is erased by irradiating the test area with a radiation beam having an erase power level before the test patterns are recorded, reading the recorded patterns will yield read signal portions wherefrom an unambiguous optimum value (P_{opt}) of the write power level (P) can be deduced.

It is to be noted that the initialization step of erasing the test area should always be executed, irrespective of whether or not any information is recorded in the test area. The initialization step of erasing the test area should be executed even when a new recording medium, i.e. a medium that is, has never been used before to record user information, is used. Experiments performed by the inventor have a much more accurate and unambiguous value (P_{opt}) of the write power level (P) could be deduced revealed especially for new recording mediums.

It is also to be noted that erasing the test area by writing the test patterns while using a Direct-Overwrite (DOW) technique, that is, writing information to be recorded in the information layer and at the same time erasing information previously written in the information layer, is inadequate. The test area should preferably be erased by a so called DC erasure, that is, applying a radiation beam having a constant erase power level without write pulses in between, before writing the test patterns. After erasure, the test patterns may be recorded using a DOW or any other recording technique.

An embodiment of the method according to the invention is characterized in that the third step includes a first intermediate step of deriving a value of a read parameter from each read signal portion, the values representing a relation between the read parameter and the write power level (P), and a second intermediate step of selecting the optimum value

(P_{opt}) of the write power level (P) in dependence on the relation between the read parameter and the write power level (P).

It is also an object of the present invention to provide an apparatus according to the opening paragraph operative to use a method according to the invention.

This object is achieved when the optical recording apparatus set forth in the preamble is characterized in that the radiation source is also equipped to emit a radiation beam for erasing information from the recording medium, the radiation beam having a controllable value of an erase power level, and in that the control unit is also operative to control the radiation source such that it applies the radiation beam having the erase power level to the test area on the recording medium before the series of test patterns are recorded on the recording medium. Such a recording apparatus is operative to erase the test area before the test patterns are recorded. The test area is erased by irradiating it with a radiation beam having an erase power level. Preferably, the radiation beam should have a constant erase power level without write pulses in between.

The objects, features and advantages of the invention will be apparent from the following more specific descriptions of examples of embodiments of the invention, as illustrated in the accompanying drawings where

Figure 1 is a flow chart of a version of the method according to the invention,

Figure 2 is a graph showing the derivative of the measured modulation as a function of the write power level,

Figure 3 shows an embodiment of the optical recording apparatus according to the invention, and

Figure 4 illustrates two read signal portions from two test patterns.

Figure 3 shows an optical recording apparatus and an optical recording medium 1 according to the invention. The recording medium 1 has a transparent substrate 2 and an information layer 3 arranged on it. The information layer 3 comprises a material suitable for recording information by means of a radiation beam 5. The recording material may be of, for example, the phase-change type, the magneto-optical type, or any other suitable material. Information may be recorded in the form of optically detectable marks on the information layer 3. The apparatus comprises a radiation source 4, for example a semiconductor laser, for emitting a radiation beam 5. The radiation beam is converged on the

information layer 3 via a beam splitter 6, an objective lens 7 and the substrate 2. Radiation reflected from the medium 1 is converged by the objective lens 7 and, after passing through the beam splitter 6, it is incident on a detection system 8 which converts the incident radiation into electric detector signals. The detector signals are applied to a circuit 9. The circuit 9 derives several signals from the detector signals, such as a read signal S_R representing the information being read from the recording medium 1. The radiation source 4, the beam splitter 6, the objective lens 7, the detection system 8 and the circuit 9 together form a read unit 100.

The read signal S_R from the circuit 9 is processed in a first processor 10 in order to derive signals representing a read parameter from the read signal S_R. The derived signals are fed to a second processor 11 which processes a series of values of the read parameter and sets, on the basis thereof, an optimum a write power control signal necessary for controlling the laser power level (P). The first processor 10 and the second processor 11 together form the setting means 200. A processor is understood to mean any means suitable for performing calculations, for example, a micro-processor, a digital signal processor, a hard-wired analog circuit or a field programmable circuit. Furthermore, the first processor 10 and the second processor 11 may be separate devices or, alternatively, may be combined into a single device executing both processes.

The write power control signal is applied to a control unit 12. An information signal 13, representing the information to be recorded on the recording medium 1, is also fed to the control unit 12. The output of the control unit 12 is connected to the radiation source 4. A mark on the recording layer 3 may be recorded by a single radiation pulse, the power of which is determined by the write power control signal as determined by the setting means 200. Alternatively, a mark may also be recorded by a series of radiation pulses of equal or different length and one or more power levels, each level being determined by the write power control signal as determined by the setting means 200.

Before recording information on the recording medium 1 the apparatus sets its write power (P) to the optimum value (P_{opt}) by performing a method according to the invention. This method is schematically depicted in the flow chart shown in figure 1.

First, in an initialization step 110, the apparatus applies a radiation beam 5 having an erase power level to the test area on the recording medium 1. The control unit 12 controls the radiation source 4 such that it emits a radiation beam 5 having a constant erase power level. When a so-called "black-writing" record carrier of the phase change type is used, the information layer 3 in the test area becomes the crystalline state. Previously written

marks, represented by amorphous areas, are erased. When a new recording medium, that is, a medium which has never been used before to record user information, is used, the information layer 3 in the test area becomes a stable and reproducible crystalline state.

Next, in the first step 111, the apparatus writes a series of test patterns in the test area on the recording medium 1. The test patterns should be selected so as to give a desired read signal. If the read parameter to be derived from the read signal is the modulation (M) of a read signal portion pertaining to a test pattern, the test pattern should comprise marks sufficiently long to achieve maximum modulation of the read signal portion. When the information is coded according to the so-called Eight-to-Fourteen Modulation (EFM), the test patterns preferably comprise the long I11 marks of the modulation scheme. When the information is coded according to the Eight-to-Fourteen Plus Modulation (EFM+), the test patterns preferably comprise the long I14 marks of this modulation scheme. Each test pattern is recorded with a different write power level (P). The range of the powers may be selected on the basis of an indicative power level (P_{ind}) recorded as control information on the recording medium. Subsequent test patterns may be recorded with a step-wise increased write power level (P) under the control of the control unit 12.

In the second step 112 the recorded test patterns are read by the read unit 90 so as to form a read signal S_R. Figure 4 shows the read signal S_R and two read signal portions 18 and 19 obtained from two test patterns written at two different write power levels. The test patterns shown comprise a short mark, a long mark and a short mark, as denoted by the signal parts 15, 16 and 17, respectively, in both the read signal portion 18 and the read signal portion 19. An actual test pattern may comprise a few hundred marks of different or equal length.

In the first intermediate step 114 of the third step 113 of the method, thr processor 10 derives from the read signal S_R a read parameter for each read signal portion 18,19. A possible read parameter is the ratio of the lowest level of the amplitude of a read signal portion (for the read signal portion 18 indicated by 'a' in Figure 4) to the maximum level of the amplitude of the same read signal portion (indicated by 'b'). A preferred read parameter is the modulation (M), being the ratio of the maximum peak-to-peak value of a read signal, indicated by 'c', to the maximum amplitude 'b' of the read signal portion.

Next, series of value pairs for the modulation (M) of a pattern and the write power (P) with which that pattern has been written are formed. The write powers may be taken from the value of the write power control signal during the recording of the test patterns or, alternatively, from a measurement of the radiation power. A curve is fitted

through the measured modulation values in order to obtain an analytic expression for the variation of the modulation as a function of the write power. This fitting may be done, for example, by means of the well-known least-squares fitting algorithm.

In the second intermediate step 115 of the third step 113 the processor 11 calculates a normalized derivative γ of the measured modulation as a function of the write power level (P). This normalized derivative $\gamma(P)$ is equal to the function $(dM/dP) \cdot P/M$. Figure 2 shows two graphs representing the normalized derivative γ of the measured modulation as a function of the write power level P. The dashed curve 21 represents the normalized derivative γ derived by using the method known from the prior art while the solid curve 22 represents the normalized derivative γ derived by using the method according to the present invention. Both graphs were obtained from measurements using identical recording media.

Next, the processor 11 derives an intermediate write power level P_i from the normalized derivative γ. The intermediate write power level P_i is derived by reading a preset value γ_0 from the recording medium and determining the value of the write power level P belonging to the preset value γ_0 as indicated by the dashed line 23 in figure 2. Finally, the optimum value (P_{opt}) of the write power level (P) is obtained by multiplying the intermediate power level P_i by a predetermined constant ρ larger than one, i.e. $P_{opt} = \rho \cdot P_i$. The preset value γ_0 and the predetermined constant ρ may have values set by the manufacturer of the recording medium and pre-recorded on the recording medium itself in an area on the recording medium comprising control information indicative of a recording process whereby information can be recorded on said recording medium.

As stated before Figure 2 shows two graphs representing the normalized derivative γ of the measured modulation as a function of the write power level P. The dashed curve 21 represents the normalized derivative γ derived by using the method known from the prior art while the solid curve 22 represents the normalized derivative γ derived by using the method according to the present invention. Both graphs were obtained from measurements using identical new recording media, i.e. media which were never used before to record user information. From figure 2 it is evident that the intermediate write power level P_i obtained by using the method according to the present invention deviates significantly from the intermediate write power level P_1 obtained by using the method known from the prior art. Experiments have revealed the normalized derivative γ derived by using the method according to the present invention (solid curve 22) was reproducible, i.e. successive OPC-procedures resulted in a substantially identical curve, whereas the normalized derivative γ

derived by using the method known from the prior art (dashed curve 21) was not. It appeared that in a second OPC-procedure using the method known from the prior art the dashed curve 21 was shifted towards the solid curve 22.

Furthermore, when a preset value γ_E is used no unambiguous value for the intermediate power level, and therefore for the optimum value (P_{opt}) of the write power level, can be derived from the normalized derivative γ derived by using the method known from the prior art (dashed curve 21). This is because the dash-dotted line 25, corresponding to the preset value γ_E, crosses the dashed curve 21 for three different values of the write power level (P). However, the normalized derivative γ derived by using the method according to the present invention (solid curve 22) was found to be represented by a monotonously decreasing function. Therefore, an unambiguous value for the intermediate power level, and therefore for the optimum value (P_{opt}) of the write power level, can always be derived because such a monotonously decreasing function has only a single value $P_{i,E}$ of the write power level (P) for which it crosses a horizontal line 25.

It should be noted that the above-mentioned versions and embodiments illustrate rather than limit the invention, and that those skilled in the art will be able to design alternatives without departing from the scope of the appended claims. Furthermore, the word “comprise” and its conjugations do not exclude the presence of steps or elements other than those listed in the claims. Any reference sign placed between parentheses in the claims shall not be construed as limiting the claims.

CLAIMS:

1. A method for setting an optimum value (P_{opt}) of a write power level (P) of a radiation beam (5) for use in an optical recording apparatus for writing information on an optical recording medium (1), the optical recording medium comprising an information layer (3) having a phase reversibly changeable between a first state and a second state, the information being written on the optical recording medium in the form of marks by applying the radiation beam to an area of the information layer so as to cause the area of the information layer to become the first state, thereby forming the mark,
the method comprising a first step of writing a series of test patterns, each test pattern comprising marks, in a test area on the recording medium, each test pattern being written with a different value of the write power level (P) of the radiation beam,
a second step of reading the written test patterns to form corresponding read signal portions, and a third step of selecting the optimum value (P_{opt}) of the write power level (P) in dependence on the read signal portions,
characterized in that the method also includes before the first step, an initialization step of applying the radiation beam having an erase power level to the test area so as to cause the information layer in the test area to become the second state.

2. A method as claimed in claim 1, characterized in that the third step includes a first intermediate step of deriving a value of a read parameter from each read signal portion, the values representing a relation between the read parameter and the write power level (P), and a second intermediate step of selecting the optimum value (P_{opt}) of the write power level (P) in dependence on the relation between the read parameter and the write power level (P).

3. An optical recording apparatus for recording information on an optical recording medium (1), comprising a radiation source (4) for emitting a radiation beam (5) for recording information on the recording medium, the radiation beam having a controllable value of a write power level (P),
a control unit (12) operative to record a series of test patterns in a test area on the recording medium, each pattern being recorded with a different value of the write power level (P),

a read unit (100) for reading the recorded test patterns and for forming corresponding read signal portions, and
setting means (200) for setting an optimum value (P_{opt}) of the write power level in dependence on the read signal portions,
characterized in that the radiation source (4) is also equipped to emit a radiation beam (5) for erasing information from the recording medium (1), the radiation beam (5) having a controllable value of an erase power level,
and in that the control unit (12) is also operative to control the radiation source (4) such that it applies the radiation beam (5) having the erase power level to the test area on the recording medium (1) before the series of test patterns are recorded on the recording medium.

4. An optical recording apparatus as claimed in claim 3, characterized in that the control unit (12) is operative to control the radiation source (4) such that is applies a radiation beam (5) having an erase power level of constant value to the test area on the recording medium (1) before the series of test patterns are recorded.

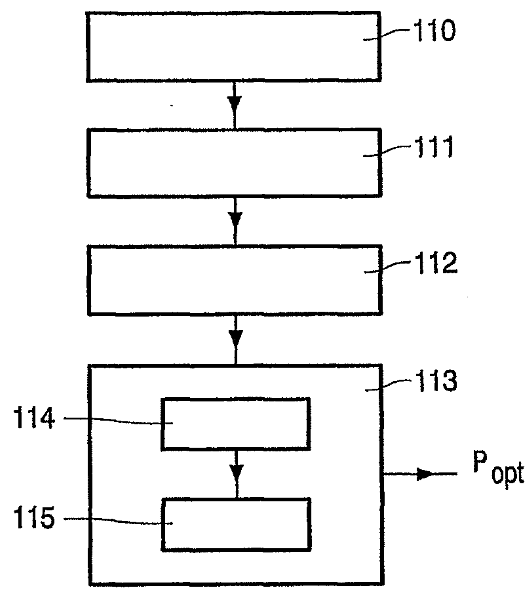
110
111
112
113
114
115
P_{opt}

FIG. 1

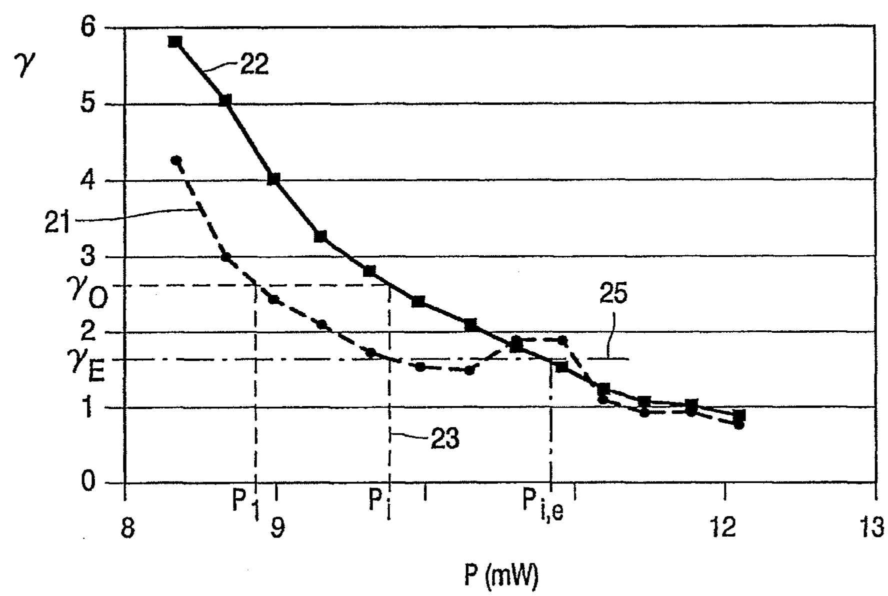
γ
6
5
4
3
2
1
0
γ_O
γ_E
22
21
25
23
P_1
P_i
$P_{i,e}$
8
9
12
13
P (mW)

FIG. 2

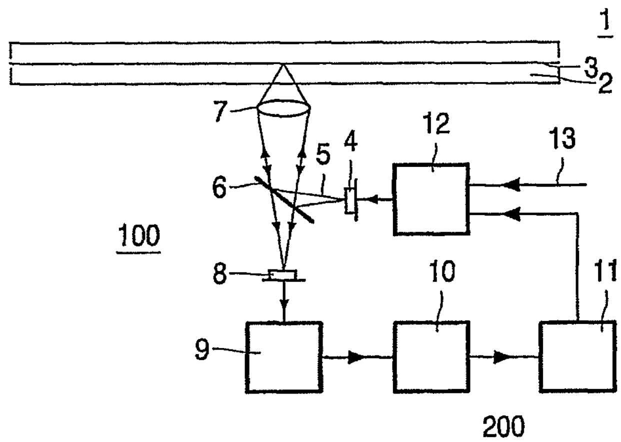

FIG. 3

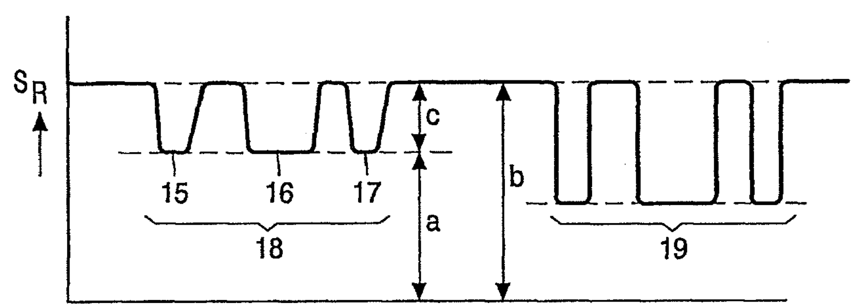

FIG. 4

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[19] 中华人民共和国国家知识产权局

[51] Int. Cl⁷
G11B 7/0045

[12] 发明专利申请公开说明书

[21] 申请号 01804477.8

[43] 公开日 2003 年 2 月 12 日

[11] 公开号 CN 1397067A

[22] 申请日 2001.11.23 [21] 申请号 01804477.8
[30] 优先权
[32] 2000.12.4 [33] EP [31] 00204315.6
[86] 国际申请 PCT/EP01/13735 2001.11.23
[87] 国际公布 WO02/47072 英 2002.6.13
[85] 进入国家阶段日期 2002.8.2

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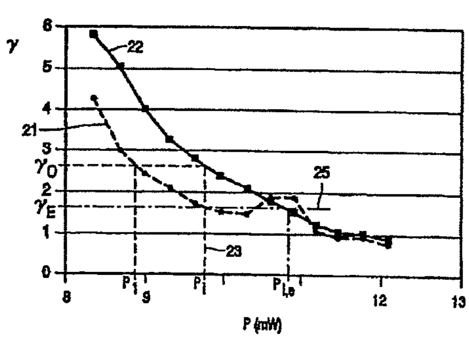
权利要求书 2 页 说明书 6 页 附图 2 页

[54] 发明名称 确定最佳写功率的方法及光学记录装置

[57] 摘要

描述了一种用于确定 OPC 过程中的最佳写功率的方法及光学记录装置。该方法包含擦除测试区，在测试区中记录测试模式，读取记录的测试模式及从读取的信号的信号部分中确定最佳写功率。即使其中未记录信号也擦除测试区能产生最佳写功率的可靠与明确的值。



ISSN 1008-4274

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1. 一种设定在光学记录装置中用来在光学记录介质（1）上写信息的辐射束（5）的写功率级（P）的最佳值（P_{opt}）的方法，该光学记录介质包括具有可在第一状态与第二状态之间可逆地改变的相位的信息层（3），信息是通过将辐射束作用在信息层上的区中来导致信息层的该区变成第一状态借此形成标记而以标记的形式写在光学记录介质上的，该方法包括在记录介质上的测试区中写一系列测试模式的第一步骤，各测试模式包括标记，各测试模式是用辐射束的写功率级（P）的不同值写的；

读取写入的测试模式来构成对应的读信号部分的第二步骤；以及

根据读信号部分选择写功率级（P）的最佳值（P_{opt}）的第三步骤，

其特征在于该方法在第一步骤之前还包括将具有擦除功率级的辐射束作用在测试区上以便导致测试区中的信息层变成第二状态的初始化步骤。

2. 如权利要求1所述的方法，其特征在于第三步骤包括从各读信号部分导出读参数的值的第一中间步骤，这些值表示读参数与写功率级（P）之间的关系；以及

根据读参数与写功率级（P）之间的关系选择写功率级（P）的最佳值（P_{opt}）的第二中间步骤。

3. 一种用于在光学记录介质（1）上记录信息的光学记录装置，包括用于发射在记录介质上记录信息的辐射束（5）的辐射源，该辐射束具有写功率级（P）的可控值；

进行操作在记录介质上的测试区中记录一系列测试模式的控制单元（12），每个模式是用写功率级（P）的不同值记录的；

用于读取记录的测试模式及用于构成对应的读信号部分的读单元（100）；以及

用于根据读信号部分设定写功率级的最佳值（P_{opt}）的设定装置（200），

其特征在于辐射源（4）还设有发射用于从记录介质（1）上擦除信息的辐射束（5），辐射束（5）具有擦除功率级的可控值，以及

该控制单元（12）还进行操作来控制辐射源（5）使它在记录介质上记录该测试模式系列之前在记录介质（1）上的测试区中作用具有擦

除功率级的辐射束（5）。

4. 如权利要求 3 所述的光学记录装置，其特征在于该控制单元（12）进行操作来控制辐射源（4）使它在记录该测试模式系列之前将具有恒定值的擦除功率级的辐射束（5）作用在记录介质（1）上的测试区中。

确定最佳写功率的方法及光学记录装置

本发明涉及为在光学记录介质上写入信息的光学记录装置中使用的辐射束的写功率级（P）设定最佳值（P_{opt}）的方法，光学记录介质包括具有可在第一状态与第二状态之间可逆地改变相位的信息层，信息是通过将辐射束作用在信息层的区中以便使信息层的该区成为第一状态借此形成标记而以标记的形式写在光学记录介质上的，本方法包括在记录介质上的测试区中写一系列测试模式的第一步骤，各测试模式包括标记，各测试模式是用辐射束的写功率级（P）的不同值写的；读取写入的测试模式以便构成对应的读信号部分的第二步骤；以及根据读信号部分选择写功率级（P）的最佳值（P_{opt}）的第三步骤。

本发明还涉及用于在光学记录介质上记录信息的光学记录装置，包括用于发射在记录介质上记录信息的辐射束的辐射源，该辐射束具有写功率级（P）的可控值；进行操作在记录介质上的测试区中记录一系列测试模式的控制单元，每个模式是用写功率级（P）的不同的值记录的；用于读取记录的测试模式及用于形成对应的读信号部分的读单元；以及用于根据读信号部分设定写功率级的最佳值（P_{opt}）的设定装置。

按照第一段的方法与装置是从欧洲专利申请号 DP0737962 已知的。该装置采用包含下述步骤的设定辐射束的最佳写功率（P_{opt}）的方法。首先该装置在记录介质上记录一系列测试模式，每个测试模式带有递增的写功率（P）。随即，它从对应于各测试模式的读信号部分得出各记录测试模式的调制（M）。它计算作为写功率（P）的函数的调制（M）的导数并通过将其乘以调制（M）上的写功率（P）标准化该导数。该标准化导数（γ）与预设定的值（γ_{target}）的交点确定目标写功率级（P_{target}）。最后，将目标写功率（P_{target}）乘以参数（P）从而得出最适合于在记录介质上记录的写功率级（P）的最佳值（P_{opt}）。参数（P）的值是从记录介质本身读取的。该测试模式是通过施加也从该记录介质本身读取的给定的值（P_{ind}）周围的范围中的写功率（P）值而记录在记录介质上的。

测试模式是记录在记录介质上的测试区中的。通常，这一测试区

是为记录测试模式专门保留的区。例如将这一保留区称作驱动器测试区或盘测试区。测试区可包含一个连续的区或者也可以由若干子区组成。

应指出未预先分布的欧洲专利申请 PHNL000685 描述另一方法及使用该另一方法的装置。在这另一方法中，写功率级(P)的最佳值(P_{opt})是直接从调制乘写功率级（即 P.M）与写功率级（P）之间的关系确定的。

在光学记录装置中，用正确的辐射束功率在光学记录介质上记录信息是重要的。由于环境及每一记录介质与记录装置组合的装置间偏差而介质制造商不能以绝对方式给出这一正确功率（例如预先记录在盘上）。设定最佳写功率（P_{opt}）的已知方法考虑进去记录介质的不同特征。此外，方法是与特定记录装置无关的。它们是设计成为记录装置与记录介质的各种组合提供辐射束的写功率的适当设定值的。这些方法通常称作 OPC（最佳功率标定）过程。

然而，已知方法的缺点在于不是总能得出最佳写功率级（P_{opt}）的明确的值的。尤其是在记录介质包括具有在第一状态与第二状态之间可逆地改变的相位的信息层的情况中，例如具有晶体与非晶体状态的相变型信息层。例如，用晶体周边内的非晶体区在这一相变型信息层上形成标记。包含相变型信息层的记录介质包括例如 CD-RW 与 DVD-RW 盘。

应指出在本申请的范围内，认为标记包含记录介质上所有可检测的区，诸如上面讨论的相变型记录介质上的晶体周边内的非晶体区。然而，标记不限于光学可检测的区，但也可使用磁或磁光可检测的区。

本发明的目的是提供按照第一段的确定写功率级的最佳值的方法。

这一目的是这样达到的：在前序部分中陈述的方法的特征在于该方法在第一步之前还包含将具有擦除功率级的辐射束作用在测试区上以便使测试区中的信息层变成第二状态的初始化步骤。当在记录测试模式之前通过用具有擦除功率级的辐射束照射测试区来擦除测试区时，读取记录的模式将产生从其中能导出写功率级（P）的明确最佳值（P_{opt}）的读信号部分。

应指出无论测试区中是否记录有任何信息都永远要执行擦除测试

区的初始化步骤。甚至在使用新记录介质，即从前从未用于记录用户信息的介质，时也必须执行擦除测试区的初始化步骤。发明人进行的实施尤其对新记录介质揭示能导出写功率级（P）的极精确与明确的值（P_{opt}）。

还应指出，在采用直接复盖（DOW）技术时通过写测试模式来擦除测试区是不够的，即在信息层中写要记录的信息并同时擦除以前写在信息层中的信息。最好应在写测试模式之前用所谓 DC 擦除擦除测试区，即作用其间没有写脉冲的具有恒定的擦除功率级的辐射束。擦除以后，可用 DOW 或任何其它记录技术记录测试模式。

按照本发明的方法的实施例的特征在于第三步骤包含从各读信号部分导出读参数的值的第一中间步骤，这些值表示读参数与写功率级（P）之间的关系；以及根据读参数与写功率级（P）之间的关系选择写功率级（P）的最佳值（P_{opt}）的第二中间步骤。

本发明的另一目的为提供按照第一段进行操作来使用按照本发明的方法的装置。

这一目的是这样达到的：前序部分中所陈述的光学记录装置的特征在于将辐射源设置成发射从记录介质上擦除信息的辐射束，该辐射束具有可控的擦除功率级的值；以及在于控制单元还进行操作来控制辐射源使得它在记录介质上记录测试模式系列之前将具有擦除功率级的辐射束作用在记录介质上的测试区上。测试区是通过用具有擦除功率级的辐射束照射它来擦除的。最好，该辐射束应具有其间不带写脉冲的恒定的擦除功率级。

从下面附图中所示出的本发明的实施例的实例的更具体的描述中，本发明的目的、特征及优点将是显而易见的，其中：

图 1 为按照本发明的方法的版本的流程图，

图 2 为示出作为写功率级的函数的测定的调制的导数的曲线，

图 3 示出按照本发明的光学记录装置的实施例，以及

图 4 示出来自两种测试模式的两个读信号部分。

图 3 示出按照本发明的光学记录装置及光学记录介质 1。记录介质 1 具有透明基板 2 及布置在其上面的信息层 3。信息层 3 包括适合于用辐射束 5 记录信息的材料。记录材料可以有诸如相变型、磁光型、或任何其它适用的材料。信息可以以光可检测的标记的形式记录在信息

层 3 上。该装置包括诸如半导体激光器等用于发射辐射束 5 的辐射源 4。辐射束经过束分裂器 6、物镜 7 与基板 2 会聚在信息层 3 上。从介质 1 反射的辐射被物镜 7 会聚，并通过束分裂器 6 后入射在将入射辐射转换成电检测器信号的检测系统 8 上。将检测器信号作用在电路 9 上。电路 9 从该检测器信号导出若干信号，诸如表示正在从记录介质 1 读取的信息的读信号 S_R。辐射源 4、束分裂器 6、物镜 7、检测系统 8 及电路 9 一起构成读单元 100。

为了从读信号 S_R 中导出表示读参数的信号，在第一处理器 10 中处理来自电路 9 的读信号 S_R。将导出的信号馈入第二处理器 11，后者处理读参数的一系列值并在其基础上设定控制激光器功率级（P）所必需的最佳写功率控制信号。第一处理器 10 与第二处理器 11 一起构成设定装置 200。将处理器理解为指称适合于执行计算的任何装置，例如微处理器、数字信号处理器、硬接线模拟电路或现场可编程电路。此外，第一处理器 10 与第二处理器 11 可以是分开的装置，或作为替代，可以组合执行两种处理的单一装置。

将写功率控制信号作用在控制单元 12 上。还将表示要记录在记录介质 1 上的信息的信息信号 13 馈入控制单元 12。将控制单元 12 的输出端连接到辐射源 4 上。可用单一的辐射脉冲记录记录层 3 上的一个标记，前者的功率是由设定装置 200 所确定的写功率控制信号确定的。此外，也可用一系列相等或不同长度及一或多个功率级的辐射脉冲记录一个标记，各级是由设定装置 200 所确定的写功率控制信号确定的。

在记录介质 1 上记录信息之前，该装置通过执行按照本发明的方法将其写功率（P）设定到最佳值（P_{opt}）上。这一方法示意性地描绘在图 1 中所示的流程图中。

首先在初始化步骤 110 中，该装置将具有擦除功率级的辐射束 5 作用在记录介质 1 上的测试区中。控制单元 12 控制辐射源 4 使得它发射具有恒定的擦除功率级的辐射束 5。当采用相变型的所谓“黑写”记录载体时，测试区中的信息层 3 变成晶体状态。擦除用非晶体区表示的以前写入的标记。当使用以前从未用来记录用户信息的新记录介质时，测试区中的信息层 3 变成稳定的与可再生的晶体状态。

接着在第一步骤 111 中，该装置将一系列测试模式写入记录介质 1 上的测试区中。应将测试模式选择为能给出所要求的读信号。如果要

从读信号导出的读参数为从属于测试模式的读信号部分的调制（M），则测试部分应包括达到读信号部分的最大调制的充分长的标记。当信息是按照所谓的 8 到 14 调制（EFM）编码时，测试模式最好包括调制方案的长 I11 标记。当信息是按照 8 到 14 加调制（EFM+）编码时，测试模式最好包括这一调制方案的长 I14 标记。用不同的写功率级（P）记录各测试模式。可在作为控制信息记录在记录介质上的指示性功率级（P_{ind}）的基础上选择功率的范围。可在控制单元 12 的控制下用逐步增加的写功率级（P）记录后面的测试模式。

在第二步骤 112 中，读单元 90 读取记录的测试模式以便构成读信号 S_R。图 4 示出读信号 S_R 及从在两个不同写功率级上写入的两个测试模式得出的两个读信号部分 18 与 19。所示的测试模式在读信号部分 18 与读信号部分 19 中分别包括一短标记、一长标记与一短标记，如用信号部分 15、16 与 17 指示的。实际的测试模式可包含数百不同或相等长度的标记。

在该方法的第三步骤 113 的第一中间步骤 114 中，处理器 10 从读信号 S_R 导出各读信号部分 18、19 的读参数。可能的读参数为读信号部分的幅值最低级（对于读信号部分 18，图 4 中用 ‘a’ 指示的）对同一读信号部分的幅度的最大级（用 ‘b’ 指示的）之比。较佳的读参数为调制（M），它是用 ‘c’ 指示的读信号的最大峰间值对该读信号部分的最大幅度 ‘b’ 之比。

接着，构成用于模式的调制（M）与用来写该模式的写功率（P）的值对系列。写功率可取自测试模式记录期间写功率控制信号之值，或者作为替代，取自辐射功率的测定值。为了获得作为写功率的函数的调制的变化的解析表达式，将一条曲线拟合通过测定的调制值。可用诸如知名的最小二乘方拟合算法完成这一拟合。

在第三步骤 113 的第二中间步骤 115 中，处理器 11 计算测定的作为写功率级（P）的函数的调制的正规化导数$\gamma(P)$。这一正规化导数$\gamma(P)$等于函数（dM/dP）·P/M。图 2 示出表示测定的作为写功率级 P 的函数的调制的正规化导数γ的两条曲线。虚曲线 21 表示用从先有技术已知的方法导出的正规化导数γ，而实曲线 22 则表示用按照本发明的方法导出的正规化导数γ。两条曲线都是从采用相同记录介质的测定值得出的。

接着，处理器 11 从正规化导数γ导出中间写功率级 P_i。中间写功率级 P_i 是通过从记录介质读取预置的值γ。并确定属于该预置的值γ_0的写功率级 P 的值来导出的，如图 2 中用虚线 23 所示，最后，通过将中间功率级 P_i 乘以大于 1 的预定常数 ρ 得出写功率级（P）的最佳值（P_{opt}），即 $P_{opt}=\rho \cdot P_i$。预置的值γ_0及预定的常数 ρ 可具有记录介质的制造商设定的值并事先记录在记录介质本身上，在包括指示记录过程的控制信息的记录介质上的区中，从而能将信息记录在所述记录介质上。

如前面所述，图 2 示出表示测定的作为写功率级 P 的函数的调制的正规化导数γ的两条曲线。虚曲线 21 表示用从先有技术已知的方法导出的正规化导数γ，而实曲线 22 表示用按照本发明的方法导出的正规化导数γ。两条曲线都是从用以前从未用来记录用户信息的相同的新记录介质的测定值得出的。从图 2 显而易见，用按照本发明的方法得出的中间写功率级 P_i 明显地偏离用先有技术已知的方法得出的中间写功率级 P_i。实验揭示用按照本发明的方法导出的正规化导数γ（实曲线 22）是可再生的，即接连的 OPC 过程得出基本上相同的曲线，然而用从先有技术已知的方法导出的正规化导数γ（虚线 21）则不然。它呈现为，在用从先有技术已知的方法的第二 OPC 过程中，虚曲线 21 是向实曲线 22 移动的。

此外，当采用预置值γ_B时，不能从用先有技术已知的方法（虚曲线 21）导出的正规化导数γ导出中间功率级的确定值并因而写功率级的最佳值（P_{opt}）的确定值。这是因为对应于预置值γ_0的点划线 25 在写功率级（P）的三个不同的值上与虚曲线 21 相交。然而，发现用按照本发明的方法（实曲线 22）导出的正规化导数γ是由单调递减的函数表示的。因此，总能导出中间功率级的确定值并因而写功率级的最佳值（P_{opt}）的确定值，因为这一单调递减的函数只有写功率级（P）的单一的值 $P_{I,B}$ 与水平线 25 相交。

应指出上述方案与实施例不是限制本发明，熟悉本技术的人员能设计替代方案而不脱离所附权利要求的范围。此外，“包括”一词及其动词变化并不排除存在权利要求中所列出的以外的步骤或元件。放在括号内的任何参照符号不应认为是限制这些权利要求。

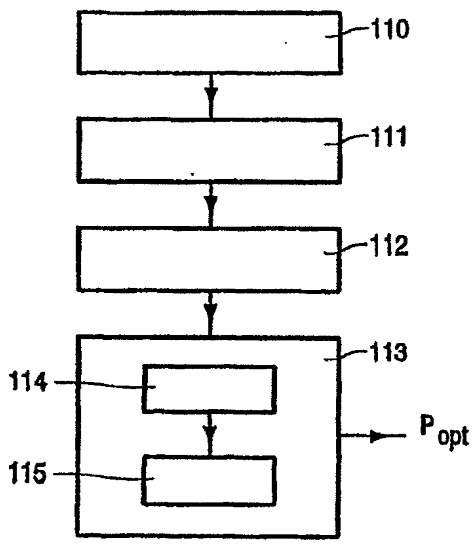
110
111
112
113
114
115
P opt

图 1

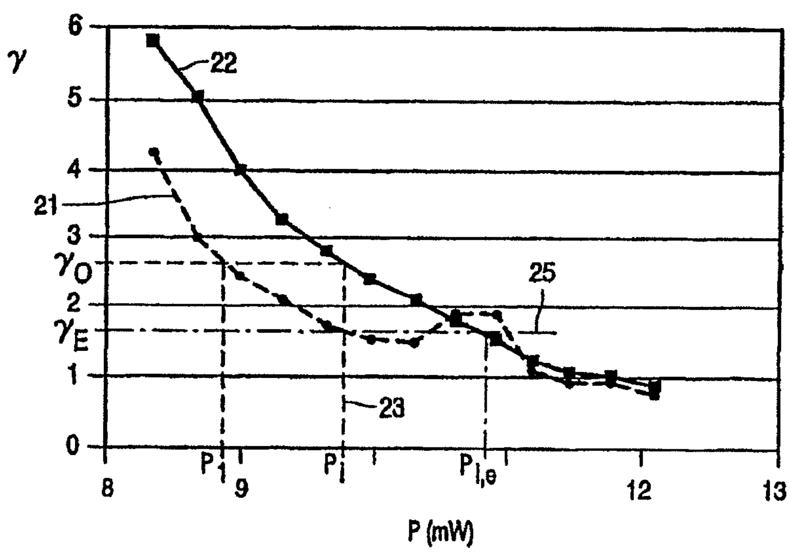
γ
6
5
4
3
2
1
0
22
21
γO
γE
25
23
P1
Pi
PI,e
8
9
12
13
P (mW)

图 2

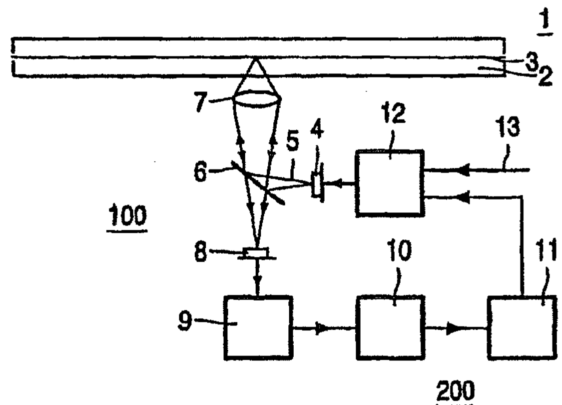

图 3

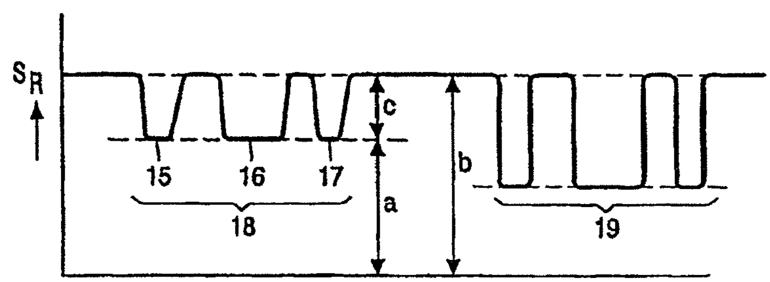

图 4